

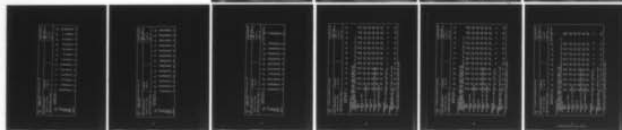
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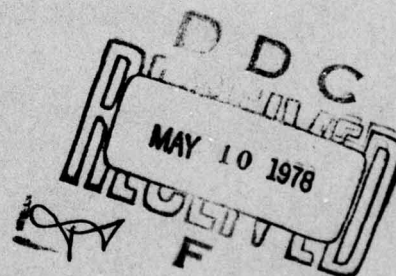


## USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK

Volume 110

A/M27T-2 Test Stand, Aircraft System,  
Electric Motor-Driven

NOVEMBER 1977



Approved for public release; distribution unlimited.

AEROSPACE MEDICAL RESEARCH LABORATORY  
AEROSPACE MEDICAL DIVISION  
AIR FORCE SYSTEMS COMMAND  
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433

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FOR THE COMMANDER



HENNING E. VON GIERKE

Director

Biodynamics and Bioengineering Division  
Aerospace Medical Research Laboratory



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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The Hydraulic Test Stand is an electric motor-driven unit designed to test aircraft hydraulic systems. This report provides measured data defining the bioacoustic environments produced by this unit operating inside a large aircraft hanger at normal rated conditions. Near-field data are reported for 37 locations in a wide variety of physical and psychoacoustic measures: overall and band sound pressure levels, C-weighted and A-weighted sound levels, preferred speech interference level, perceived noise level, and limiting times		

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for total daily exposure of personnel with and without standard Air Force ear protectors. Refer to Volume 1 of this handbook, "USAF Bioenvironmental Noise Data Handbook, Vol 1: Organization, Content and Application," AMRL-TR-75-50(1) 1975, for discussion of the objective and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc.

## PREFACE

This report was prepared by the Biodynamic Environment Branch, Aerospace Medical Research Laboratory, under the Project/Task 723104, Measurement and Prediction of Noise Environments of Air Force Operations.

The author acknowledges the efforts of Mr. Robert G. Powell who assisted the field measurements, and Mr. John N. Cole who established the data analysis requirements and assisted in the preparation of this report. Mr. Henry Mohlman and Mr. David Eilerman of the University of Dayton assisted in the mechanics of data processing, and Mrs. Norma Peachey typed and prepared the graphics.

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## INTRODUCTION

The A/M27T-2 Hydraulic Test Stand is an electric motor-driven unit designed to test aircraft hydraulic systems.

This volume provides measured data defining the bioacoustic environments produced by this unit. Such data are essential to evaluate ear protection requirements, limiting personnel exposure times, voice communication capabilities, and annoyance problems associated with operations of the A/M27T-2 test stand.

This volume is one of a series published by the Aerospace Medical Research Laboratory (AMRL) under the same report number (AMRL-TR-75-50) as a multi-volume handbook that quantifies the noise environments produced at flight/ground crew locations and in surrounding communities by operations of Air Force aircraft and ground support equipment. The far-field, community-type, noise data in the handbook describe the noise produced during *ground operations* of aircraft, ground support equipment, and other ground-based equipment or facilities.

Volume 1 of this handbook discusses the objectives and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc. Volume 2 provides a method and data for adjusting the handbook's far-field noise data, which are for standard meteorological conditions (15C temperature, 70% rel humidity, 0.760 meters Hg barometric pressure) to derive comparable data for other meteorological conditions. *Refer to Volumes 1 and 2* (references 1 and 2) for such information because it is not repeated in other handbook volumes.

A cumulative index lists those aerospace systems contained in the handbook, and identifies the specific volumes containing each type of environmental noise data available (i.e., inflight/flight crew and passenger noise, near-field/ground crew noise, far-field/community noise). Volume numbers are assigned sequentially as individual volumes are published. This index is periodically updated as individual volumes are published, and is available upon request from AMRL/BBE, Wright-Patterson AFB, OH 45433. Organizations on the distribution list for the handbook will automatically receive a copy of the updated index as it is generated.

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- 
1. Cole, John N., *USAF Bioenvironmental Noise Data Handbook, Volume 1: Organization, Content and Application*, AMRL-TR-75-50 (1), Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio, 1975.
  2. Cole, John N., *USAF Bioenvironmental Noise Data Handbook, Volume 2: Procedure to Evaluate Effects of Non-standard Meteorological Conditions on Far-Field Noise*, AMRL-TR-75-50 (2), AMRL, WPAFB, OH, 1975.



## NEAR-FIELD NOISE

### MEASUREMENTS

A standard A/M27T-2 test stand was operated inside and approximately in the center of a large aircraft hanger (190.5 m long x 95.1 m wide x 18.3 m high) on a concrete floor at a normal rated condition of the system pressurized at 3000 PSI, no flow. No far-field acoustic data were acquired because of the relatively close proximity of the hanger walls.

Figure 1 identifies 36 noise measurement locations at a height of 1.5 meters above the concrete apron (nominal ear level of ground crew). The 0 degree reference direction passes through the tow bar. These locations are in the acoustic near-field of the source where the sound wave fronts generally do not spherically diverge and the source appears to be spatially distributed (i.e., not a point source). Consequently, these near-field data cannot be extrapolated to longer distances but do properly define the levels at locations close to the unit.

Near-field measurements were also made at ear level at the operator control panel. Table 1 lists the numeric/alphabetic designator used on the data pages in this report to identify the operator measurement location and test condition. The designator 1/A means operator location 1 and test condition A. Such a descriptor is essential in many handbook volumes that involve multiple combinations of location conditions. It is used in this report to maintain format consistency.

### RESULTS

The measured data presented in Table 2 define the sound pressure levels (SPL) produced by the A/M27T-2 unit at the 37 specified, near-field locations. This table includes the overall, 1/3 octave band, and octave band levels. From these data one can calculate the variety of measures in Table 3 which are widely used to assess the effects of noise on personnel and their performance.

For data at other intermediate near-field locations (i.e., for radial distances less than 4 meters) you can interpolate between the 36 measured data points.

TABLE 1

#### MEASUREMENT LOCATION AND TEST CONDITION FOR OPERATOR NOISE MEASUREMENTS

A/M27T-2 Test Stand, Aircraft Hydraulic System, Electric Motor-Driven  
Edwards AFB, 10 May 1977

##### *Measurement Location*

1

Operator Control Panel

##### *AGE Operation*

A

*System Pressurized at  
3000 PSI, No Flow*

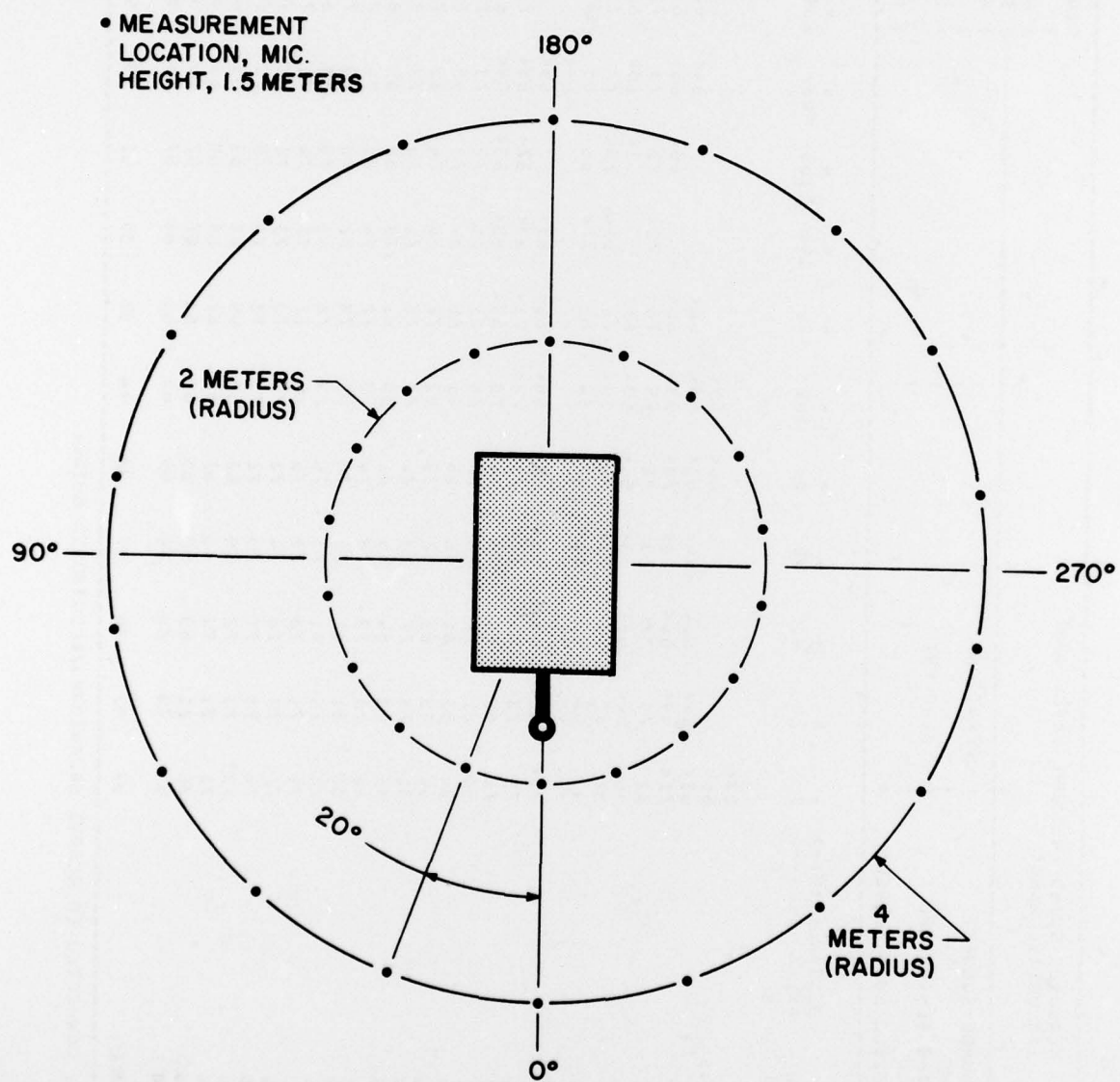


Figure 1. Measurement Locations

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)		IDENTIFICATION:															
1/3 OCTAVE BAND																	
2																	
NOISE SOURCE/SUBJECT:		OPERATIONS:															
A/M271-2 TEST STAND		( 3000 PSI															
NEAR FIELD NOISE LEVELS		(															
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TABLE: MEASURED SOUND PRESSURE LEVEL (DB)														IDENTIFICATION:			
2														OMEGA 3.2			
														TEST 77-006-001			
NOISE SOURCE/SUBJECT: ( OPERATION: )														RUN 02			
A/M271-2 TEST STAND ( 3000 PSI )														10 MAY 77			
NEAR FIELD NOISE LEVELS ( )														PAGE F2			
DISTANCE (M)-->														2			
ANGLE (DEG)-->														2			
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TABLE: MEASURED SOUND PRESSURE LEVEL (DB)										IDENTIFICATION:	
1/3 OCTAVE BAND											
2										OMEGA 3.2	
NOISE SOURCE/SUBJECT:										TEST 77-006-001	
( OPERATION:										RUN 03	
( A/M27T-2 TEST STAND										10 MAY 77	
( ( 3000 PSI											
( (											
( NEAR FIELD NOISE LEVELS (										PAGE F3	
DISTANCE (M)--> 2 2 2 2 2 2 2 2 2 2										OPERATOR POSITION	
ANGLE (DEG)--> 160 180 200 220 240 260 280 300 320 340										1/A	
FREQ (HZ)											
25	60<	61<	64<	67<	66<	61<	60<	60<	60<	65<	65<
31.5	65<	66<	65<	66<	64<	68<	65<	65<	65<	66<	66<
40	71<	72<	71<	69<	68<	71<	69<	69<	69<	70<	70<
50	81<	82<	81<	78<	76<	80<	82<	83<	83<	75<	75<
63	84<	85<	84<	81<	78<	83<	85<	86<	86<	84<	84<
80	76<	77<	76<	72<	70<	73<	73<	73<	73<	69<	69<
100	87<	87<	82<	78<	78<	81<	81<	82<	82<	80<	80<
125	71<	73<	70<	67<	68<	68<	69<	72<	72<	77<	77<
160	70<	72<	68<	66<	68<	71<	72<	75<	75<	79<	79<
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250	71<	70<	70<	69<	70<	73<	73<	75<	75<	76<	76<
315	76<	76<	74<	75<	75<	76<	76<	79<	79<	81<	81<
400	89<	90<	95<	89<	92<	93<	93<	95<	95<	101<	101<
500	82<	81<	85<	84<	84<	84<	84<	86<	86<	90<	90<
630	75<	76<	77<	75<	76<	75<	76<	79<	79<	82<	82<
800	85<	89<	92<	84<	84<	89<	90<	84<	85<	96<	96<
1000	79<	81<	83<	77<	77<	81<	82<	79<	82<	89<	89<
1250	83<	85<	82<	84<	85<	84<	85<	86<	86<	96<	96<
1600	87<	91<	89<	88<	81<	82<	82<	80<	82<	99<	99<
2000	84<	84<	83<	81<	77<	79<	79<	79<	81<	92<	92<
3150	77<	80<	76<	77<	76<	77<	77<	77<	79<	86<	86<
4000	78<	80<	77<	77<	76<	77<	77<	76<	80<	88<	88<
5000	77<	76<	74<	74<	73<	74<	73<	73<	77<	85<	85<
6300	74<	78<	77<	74<	71<	71<	71<	71<	74<	88<	88<
8000	74<	74<	73<	69<	70<	70<	70<	73<	74<	87<	87<
10000	72<	73<	73<	68<	68<	68<	68<	71<	76<	88<	88<
OVERALL	95	97	98	93	95	96	97	99	103	105	105

< LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)													
OCTAVE BAND													
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IDENTIFICATION:													
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TABLE: MEASURED SOUND PRESSURE LEVEL (DB)										IDENTIFICATION:									
OCTAVE BAND																			
2										OMEGA 3.2									
NOISE SOURCE/SUBJECT:										TEST 77-006-001									
( OPERATION:										RUN 02									
A/M27T-2 TEST STAND										10 MAY 77									
NEAR FIELD NOISE LEVELS										PAGE J2									
DISTANCE (M)-->																			
ANGLE (DEG)-->																			
FREQ (HZ)	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110
31.5	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
63	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92
125	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
250	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87
500	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
1000	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85
2000	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84
4000	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83
8000	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82
OVERALL	90	94	93	100	104	101	106	98	95	95	95	95	95	95	95	95	95	95	94

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)										IDENTIFICATION:	
OCTAVE BAND											
2											
NOISE SOURCE/SUBJECT:											
( OPERATION:											
( 3000 PSI											
A/M271-2 TEST STAND											
( 10 MAY 77											
NEAR FIELD NOISE LEVELS											
( PAGE J3											
DISTANCE (M)--> 2 2 2 2 2 2 2 2 2 2											
ANGLE (DEG)--> 160 180 200 220 240 260 280 300 320 340											
FREQ (HZ)											
31.5											
63											
125											
250											
500											
1000											
2000											
4000											
8000											
OVERALL											

TABLE: MEASURES OF HUMAN NOISE EXPOSURE														IDENTIFICATION:	
3															
NOISE SOURCE/SUBJECT: ( OPERATION: )														OMEGA 3.2	
A/M27T-2 TEST STAND ( 3000 PSI )														TEST 77-006-001	
NEAR FIELD NOISE LEVELS ( )														RUN 01	
														10 MAY 77	
														PAGE H1	
HAZARD/PROTECTION															
C-WEIGHTED OVERALL SOUND LEVEL (OASLC IN DB) AT EAR															
A-WEIGHTED OVERALL SOUND LEVEL (OASLA IN DB) AT EAR															
MAXIMUM PERMISSIBLE TIME (T IN MINUTES) FOR ONE EXPOSURE PER DAY (AFR 161-35, JULY 73)															
NO PROTECTION															
OASLC	97	97	95	97	91	94	92	90	92	95	90	94	92		
OASLA	94	93	91	94	89	92	90	89	90	92	89	92	91		
T	85	101	143	85	202	120	170	202	170	120	202	120	143		
MINIMUM QPL EAR MUFFS															
OASLA*	74	75	72	74	68	70	68	64	67	71	65	70	66		
T	960	960	960	960	960	960	960	960	960	960	960	960	960		
AMERICAN OPTICAL 1700 EAR MUFFS															
OASLA*	68	69	67	68	62	64	63	59	62	66	60	64	60		
T	960	960	960	960	960	960	960	960	960	960	960	960	960		
V-51R EAR PLUGS															
OASLA*	70	70	65	72	65	67	65	62	65	68	64	69	66		
T	960	960	960	960	960	960	960	960	960	960	960	960	960		
AMERICAN OPTICAL 1700 EAR MUFFS PLUS V-51R EAR PLUGS															
OASLA*	56	55	53	56	50	52	52	48	53	52	51	53	53		
T	960	960	960	960	960	960	960	960	960	960	960	960	960		
H-133 GROUND COMMUNICATION UNIT															
OASLA*	67	65	64	63	60	62	63	61	64	62	62	61	64		
T	960	960	960	960	960	960	960	960	960	960	960	960	960		
COMMUNICATION															
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)															
PSIL	89	88	85	87	84	86	85	84	84	80	84	86	86		
ANNOYANCE															
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNOB)															
TONE CORRECTION (C IN DB)															
PNLT	100	109	106	110	104	106	105	105	105	108	105	108	106		
C	3	3	3	5	4	4	4	3	4	5	4	5	4		
* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.															



TABLE: MEASURES OF HUMAN NOISE EXPOSURE	IDENTIFICATION:															
3																
NOISE SOURCE/SUBJECT:	OMEGA 3.2 TEST 77-006-001															
A/M271-2 TEST STAND	RUN 02															
NEAR FIELD NOISE LEVELS	10 MAY 77															
	PAGE H2															
DISTANCE (M)-->	4	4	4	4	4	4	2	2	2	2	2	2	2	2	2	2
ANGLE (DEG)-->	260	260	280	300	320	340	0	20	40	60	80	100	120	140		
HAZARD/PROTECTION																
C-WEIGHTED OVERALL SOUND LEVEL (OASLC IN DB) AT EAR																
A-WEIGHTED OVERALL SOUND LEVEL (OASLA IN DB) AT EAR																
MAXIMUM PERMISSIBLE TIME (T IN MINUTES) FOR ONE EXPOSURE PER DAY (AFR 161-35, JULY 73)																
NO PROTECTION																
OASLC	90	94	93	100	104	101	101	100	97	95	95	95	95	94	94	
OASLA	88	91	90	97	101	97	102	102	93	92	93	93	93	93	93	
T	240	143	170	50	25	50	21	101	101	120	101	101	101	101	101	
MINIMUM QPL EAR MUFFS																
OASLA*	66	70	70	70	81	79	83	75	72	71	71	71	71	70	69	
T	960	960	960	960	807	960	571	960	960	960	960	960	960	960	960	
AMERICAN OPTICAL 1700 EAR MUFFS																
OASLA*	61	64	64	71	75	73	77	70	67	65	65	65	64	63	63	
T	960	960	960	960	960	960	960	960	960	960	960	960	960	960	960	
V-51R EAR PLUGS																
OASLA*	65	68	67	74	79	72	80	68	68	68	69	69	68	68	68	
T	960	960	960	960	960	960	960	960	960	960	960	960	960	960	960	
AMERICAN OPTICAL 1700 EAR MUFFS PLUS V-51R EAR PLUGS																
OASLA*	49	52	51	58	62	59	64	55	54	54	53	53	53	54	54	
T	960	960	960	960	960	960	960	960	960	960	960	960	960	960	960	
H-133 GROUND COMMUNICATION UNIT																
OASLA*	58	59	60	65	66	70	71	66	64	64	63	63	64	64	64	
T	960	960	960	960	960	960	960	960	960	960	960	960	960	960	960	
COMMUNICATION																
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)	83	84	84	90	91	92	96	88	87	88	88	88	88	88	88	
PSIL																
ANNOYANCE																
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNOB)																
TONE CORRECTION (C IN DB)																
PNLT	103	106	106	113	112	112	110	109	108	109	109	109	109	109	108	
C	3	4	4	5	4	3	4	3	3	4	4	4	4	4	4	
* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.																

